IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent Application of	
INOUE et al.	**Art Unit 2186**
Application Number: 10/768,146	
Filed: February 2, 2004	
For: DISK ARRAY DEVICE AND MAINTENANCE METHOD FOR DISK ARRAY DEVICE	
Atty Docket No. WILL.0005	

Honorable Assistant Commissioner for Patents
Washington, D.C. 20231

PETITION TO MAKE SPECIAL UNDER 37 C.F.R. § 1.102(d)

FOR ACCELERATED EXAMINATION

Sir:

Pursuant to 37 C.F.R. § 1.102(d), Applicant respectively requests that the application be examined on the merits in conjunction with the pre-examination search results, the detailed discussion of the relevance of the results and amendments as filed concurrently.

Substantive consideration of the claims is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicant's undersigned representative at the address and telephone number indicated below.

Respectfully submitted,

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STATEMENTS & PRE-EXAMINATION SEARCH REPORT SUPPLEMENTAL TO THE PETITION TO MAKE SPECIAL

Sir:

Pursuant to 37 C.F.R. §§ 1.102 and MPEP 708.02 VIII, Applicant hereby submits that (1) all claims of record are directed to a single invention, or if the Office determines that all the claims presented are not obviously directed to a single invention, will make an election without traverse as a prerequisite to the grant of special status; (2) a pre-examination search has been conducted according to the following field of search; (3) copies of each reference deemed most closely related to the subject matter encompassed by the claims are enclosed; and (4) a detailed discussion of the references pointing out how the claimed subject matter is patentable over the references is also enclosed herewith.

FIELD OF THE SEARCH

The field of search covered Class 711, subclasses 114 (U.S. & Foreign) and 162 (U.S. & Foreign). Additionally, a computer database search was conducted on the U.S.P.T.O. systems EAST and WEST for U.S. and foreign patents; a literature search was also conducted on the Internet for relevant non-patent documents, and a keyword search was also conducted in Class 711, subclasses 5, 112, 113 and 173 and Class 714, subclass 42. Examiner David Robertson in Class 711 (Art Unit 2186) was consulted in confirming the field of search.

The search was directed towards a disk array device and maintenance method for disk array device. In particular, the search was directed towards claims 1-15 of U.S. Application No. 10/768,146. All pending claims depend from claims 1, 2. and 11. Claim 1 is representative and sets forth a disk array device comprising clusters with control memory packages (cache) storing control information and expanded control memory packages (cache) storing directory information. Management information is multiplexed by the control memories. Claim 2 sets forth first and second control information stored in separate control memories. Claim 11 sets forth a related method where information stored in the control memory is restored upon detection of a failure.

With reference to the disclosure, FIG. 1 illustrates a disk array device 10 arranged into clusters 11A and 11B. Each cluster includes channel adapters CHA (e.g. 20A, 20B), disk adapters DKA (e.g. 30A, 30B) connected by a memory unit 12. The memory unit 12 includes plural cache packages 50 and 60. See page 21, ln. 4-16. The cache packages 50 (housing cache memories 51) are classified as "basic" or "option," and the cache packages 60 (housing shared memories 61) are classified as "basic" or "option." See page 21, ln. 17-25. The basic units are standard, and the option units are expanded memory. Id. The shared memories 61 store two types of control information, namely "management information" and "directory information." See page 23, ln. 18-25. The management information controls the entire device whereas the directory information depends upon the cluster in which it is mounted. See page 24, ln. 1-19. The shared memories cooperate to multiplex the management information therebetween such that expanded "option" memories also receive the management information to, inter alia, reduce data transfer bottleneck during block processing. Although the management information is managed in the clusters 11A and 11B, respectively, the management information controls an operation and the like of the entire device and does not depend upon a cluster. Contents of the management information, which exists in the separate clusters, respectively, are managed so as to coincide with each other.

With reference to the claims, a disk array device comprises clusters with basic control memory packages storing control information and expanded control memory packages storing directory information, such that management information is multiplexed by the control memories or first and second control information are stored in separate control memories. (See Conclusion paragraph for detailed references to drawings and specification).

LIST OF RELEVANT REFERENCES

The search revealed the following U.S. patents, which are listed for convenience:

U.S. Patent Number	**Inventor(s)**
6,834,289	Kaneda et al.
Published Patent Application	**Inventor(s)**
2001/0049773	Bhavsar
2003/0191891	Tanaka et al.
2003/0204683	Okumoto et al.
2003/0221074	Satoyama et al.
2004/0103244	Fujimoto et al.
2005/0050401	Matsuki et al.
Non-Patent Literature	**Author(s)**
Adaptec Storage Management ...	Adaptec

Discussion of References:

U.S. Patent No. 6,834,289 to **Kaneda** et al. discloses an information processing system and a storage area allocation method. FIG. 1 illustrates a system configuration including three computers 101, 102, 151, three disk array systems 201, 202, 203, a library system 301, and a fibre channel switch 501. See col. 3, ln. 9-33. The computers 101, 102, 151, the disk array systems 201, 202, 203, and the library system 301 are connected to the fiber channel switch 501. Id. The computer 151 provides a location management unit 801, which communicates with the computer 101 or 102 through a LAN (Ethernet) 60. See col. 3, ln. 33-41. The location management unit 801 provides an area management table 812. See col. 3, ln. 42-45. FIG. 3 illustrates the area management table 812, which is prepared for each disk array system in the case of the disk array system 201, 202 or 203 or for each medium in the case of the library system 301. See col. 3, ln. 46-67. The file system 10 of the computer 101 requests the location management unit 801 of the computer 151 to allocate a new area to the data. See col. 6, ln. 1-13. The location management unit 801 enables to obtain the allocable location from all the storages. See col. 6, ln. 13-31. However, **Kaneda**'s

location management unit 801 does not provide for cache cluster management. As such, **Kaneda** does not provide "each of the clusters including: channel adapters 20; disk adapters 30; cache memory packages; basic control memory packages 60A which are mounted with basic control memories 61A storing management information concerning a device configuration and a device operation of said disk array device 10; and expanded control memory packages 60B which are mounted with expanded control memories 61B storing directory information concerning a storage structure of the respective cache memories 50. The management information is multiplexed by the respective basic control memories 61A of the respective cluster and stored therein" as recited in claim 1, and "each of the clusters including the channel adapters, the disk adapters, and the cache memory packages recited in claim 1, as well as plural control memory packages which are used by the channel adapters and the disk adapters and have control memories storing control information. The first control information is stored in at least one of the control memories in each cluster, respectively, to be multiplexed across the clusters, and the first control information is management information which is used for controlling an operation of the disk array device." as recited in claims 2 and 11.

U.S. Pub. No. 2001/0049773 to **Bhavsar** discloses a fabric cache including a plurality of cache devices connected to a switching fabric. FIG. 1 illustrates a fabric 10 that interconnects various work stations 12, local and remote servers 14 and 16, disk storage systems 18, and other computer systems 22. See section [0026]. Cache memory is therefore placed within the fabric 10 itself. Id. Such a device is implemented as a FICD (i.e., a Fabric or Infrastructure Cache Device). See section [0034]. The management of the FICD may be through web browser interface management tools. See section [0065]. Enable/disable caching is provided by a port number on the FICD. See section [0066]. If caching is enabled on a specific port of the FICD, all storage device data passing through may be cached. If caching is disabled on a specific port of the FICD, all dirty data of a write back cache will be de-staged to the appropriate device. Id. Fig. 11. Write caches may be included in FICD(s). In this case, the write data is saved in one or more FICD(s) before actual data is written onto disk or permanent media. The FICD receiving the command will respond with a good ending status indication after receiving all the write data into the fabric cache. The dirty data will be written to the disk later. See section [0096]. However, **Bhavsar** merely selects cache within the fabric 10 by selecting a specific port, not by any cache clustering. **Bhavsar** simply does

not set forth a disk array device comprising plural clusters each with basic control memory packages storing control/management information of *the whole device* and expanded control memory packages storing directory information of *the respective cache*. **Bhavsar** neither multiplexes management information of *the whole device* by the control/management memories. As such, **Bhavsar** does not provide "each of the clusters including: channel adapters 20; disk adapters 30; cache memory packages; basic control memory packages 60A which are mounted with basic control memories 61A storing management information concerning a device configuration and a device operation of said disk array device 10; and expanded control memory packages 60B which are mounted with expanded control memories 61B storing directory information concerning a storage structure of the respective cache memories 50. The management information is multiplexed by the respective basic control memories 61A of the respective cluster and stored therein" as recited in claim 1, and "each of the clusters including the channel adapters, the disk adapters, and the cache memory packages recited in claim 1, as well as plural control memory packages which are used by the channel adapters and the disk adapters and have control memories storing control information. The first control information is stored in at least one of the control memories in each cluster, respectively, to be multiplexed across the clusters, and the first control information is management information which is used for controlling an operation of the disk array device." as recited in claims 2 and 11.

U.S. Pub. No. 2003/0191891 to **Tanaka** et al. discloses a disk storage system having disk arrays connected through disk adaptors and through switches. FIG. 8 illustrates a disk storage system fibre channel and switches SW1, SW2 are used as a data transfer system between disk adapters DKA1, DKA2 and a disk array DA1. See section [0198]. The disk storage system includes disk controllers DKC1, DKC2, the switches SW1, SW2 and the disk array DA1. See section [0199]. The switches SW1 and SW2 perform rate conversion, multiplexing and demultiplexing of data transfer. See section [0200]. In order to manage throughput, the data path is set n.congruent.m, that is, the number of ports to be changed over periodically is required to be set to be substantially equal to the ratio of the data transfer rate per channel between the disk adapter and the switch to the data transfer rate per channel between the switch and the disk array. See section [0147]. However, Tanaka's selective data path switches SW1 and SW2 are provided on a port level between the disk adaptors DKAs and the disks DKs (Fig. 8), and not on a control/cache memory level of clusters. As such,

Tanaka does not provide "each of the clusters including: channel adapters 20; disk adapters 30; cache memory packages; basic control memory packages 60A which are mounted with basic control memories 61A storing management information concerning a device configuration and a device operation of said disk array device 10; and expanded control memory packages 60B which are mounted with expanded control memories 61B storing directory information concerning a storage structure of the respective cache memories 50. The management information is multiplexed by the respective basic control memories 61A of the respective cluster and stored therein" as recited in claim 1, and "each of the clusters including the channel adapters, the disk adapters, and the cache memory packages recited in claim 1, as well as plural control memory packages which are used by the channel adapters and the disk adapters and have control memories storing control information. The first control information is stored in at least one of the control memories in each cluster, respectively, to be multiplexed across the clusters, and the first control information is management information which is used for controlling an operation of the disk array device." as recited in claims 2 and 11.

U.S. Pub. No. 2003/0204683 to **Okumoto** et al. discloses a method, a system and a storage controller for controlling shared memories. FIG. 1 illustrates the configuration of a network that includes a shared memory control system. FIG. 3 illustrates a sequence in which the shared memory control is exercised. See section [0027]. A flow of I/O data exchange among disk array devices 50 is provided by storage controllers 51. Id. Each storage controller 51 reserves, in advance, appropriate areas within its local shared memory by performing address mapping for the shared memories of other storage controllers connected via the switching device 40. Id. Shared memory update may be performed at fixed intervals such as once per week or month, when another storage controller is added or deleted. See section [0028]. When the time for synchronizing the shared memories 53 comes (step s301), the storage controller 51 first checks whether any disk array device 50 is added or deleted. See section [0029]. If the number of disk array devices has been changed (step s302), the storage controller 51 identifies the shared memory of the associated disk array device (step s303). Id. However, **Okumoto**'s shared memory updating scheme does not involve multiplexing management information between memories. As such, **Okumoto** does not provide "each of the clusters including: channel adapters 20; disk adapters 30; cache memory packages; basic control memory packages 60A which are mounted with basic

control memories 61A storing management information concerning a device configuration and a device operation of said disk array device 10; and expanded control memory packages 60B which are mounted with expanded control memories 61B storing directory information concerning a storage structure of the respective cache memories 50. The management information is multiplexed by the respective basic control memories 61A of the respective cluster and stored therein" as recited in claim 1, and "each of the clusters including the channel adapters, the disk adapters, and the cache memory packages recited in claim 1, as well as plural control memory packages which are used by the channel adapters and the disk adapters and have control memories storing control information. The first control information is stored in at least one of the control memories in each cluster, respectively, to be multiplexed across the clusters, and the first control information is management information which is used for controlling an operation of the disk array device." as recited in claims 2 and 11.

U.S. Pub. No. 2003/0221074 to **Satoyama** et al. discloses a computer system and a method of replication. FIG. 1 illustrates a cluster-structured storage system 1, a server using data stored in the cluster-structured storage system 1, and a user input device 4. See section [0030]. The cluster-structured storage system 1 includes a plurality of clusters 11 and an inter-cluster connecting mechanism 12 connecting the clusters 11. See section [0031]. Further, the inter-cluster switching mechanism 12 may be a switch or a communication line. Id. In order to achieve a snapshot between clusters, every cluster 11 has a pair information table 21 and a volume information table 31. See section [0049]. The volume information table 31 of a cluster 11 has the information of all the volumes contained in the cluster 11. Id. On the other hand, in the pair information table 21 of the cluster 11, only the information of a pair related to the cluster 11 is registered, such that the information of pairs that the whole cluster-structured storage system 1 includes is distributed to and held by each cluster. Id. However, **Satoyama**'s inter-cluster connections and pair information tables do not multiplex management information for expanding option memories. As such, **Satoyama** does not provide "each of the clusters including: channel adapters 20; disk adapters 30; cache memory packages; basic control memory packages 60A which are mounted with basic control memories 61A storing management information concerning a device configuration and a device operation of said disk array device 10; and expanded control memory packages 60B which are mounted with expanded control memories 61B storing directory information

concerning a storage structure of the respective cache memories 50. The management information is multiplexed by the respective basic control memories 61A of the respective cluster and stored therein" as recited in claim 1, and "each of the clusters including the channel adapters, the disk adapters, and the cache memory packages recited in claim 1, as well as plural control memory packages which are used by the channel adapters and the disk adapters and have control memories storing control information. The first control information is stored in at least one of the control memories in each cluster, respectively, to be multiplexed across the clusters, and the first control information is management information which is used for controlling an operation of the disk array device." as recited in claims 2 and 11.

U.S. Pub. No. 2004/0103244 to **Fujimoto** et al. discloses a system and managing method for cluster type storage. FIG. 1 illustrates a storage system 1 including transformation units 10 that function as interfaces with servers 3, hard drives 2, data caching control units 21, and system management units 60. See section [0054]. An interconnection 31 is used for the connection between the protocol transformation units 10, the data caching control units 21, and the system management units 60. Id. The interconnection 31 is configured by two switch units 51 to allocate two data paths. See section [0055]. FIG. 9 illustrates the data caching control unit 21 including, inter alia, a cache memory unit 111 for storing data to be sent/received to/from the servers 3 or the hard drives 2. See section [0060]. The number of component of each system may be varied as needed. See section [0065]. However, **Fujimoto** varies the number of system components by re-configuring the system management unit and the switch units, rather than through multiplex of management information to expanded option memories. As such, **Fujimoto** does not provide "each of the clusters including: channel adapters 20; disk adapters 30; cache memory packages; basic control memory packages 60A which are mounted with basic control memories 61A storing management information concerning a device configuration and a device operation of said disk array device 10; and expanded control memory packages 60B which are mounted with expanded control memories 61B storing directory information concerning a storage structure of the respective cache memories 50. The management information is multiplexed by the respective basic control memories 61A of the respective cluster and stored therein" as recited in claim 1, and "each of the clusters including the channel adapters, the disk adapters, and the cache memory packages recited in claim 1, as well as plural control memory packages which

are used by the channel adapters and the disk adapters and have control memories storing control information. The first control information is stored in at least one of the control memories in each cluster, respectively, to be multiplexed across the clusters, and the first control information is management information which is used for controlling an operation of the disk array device." as recited in claims 2 and 11.

U.S. Pub. No. 2005/0050401 to **Matsuki** et al. discloses a disk array system and a fault information control method. FIG. 1 illustrates a storage device system 600 including a storage device controller 100 and a storage devices 300. See section [0049]. The storage device controller 100 controls the storage devices 300 according to commands received from respective information processing units 200. Id. Data is stored in a logical volume ("LU") that is logically defined in a physical storage area. Id. The storage device controller 100 includes a management terminal 160. See section [0067]. The management terminal 160 checks the operating state of the storage device system 600, specifies a failing region in the storage device system 600, and installs an OS in channel control units 110. See section [0077]. FIG. 2 illustrates the management terminal 160 that includes a CPU 161, a memory 162, a port 163, and a storage device 168. See section [0080]. The CPU 161 is responsible for controlling the entire management terminal 160 and runs a program 162c stored in the memory 162 in accordance with a LU management table 162b. See section [0081]. However, **Matsuki**'s management terminal 160 does not multiplex management information for expanding option memories. As such, **Matsuki** does not provide "each of the clusters including: channel adapters 20; disk adapters 30; cache memory packages; basic control memory packages 60A which are mounted with basic control memories 61A storing management information concerning a device configuration and a device operation of said disk array device 10; and expanded control memory packages 60B which are mounted with expanded control memories 61B storing directory information concerning a storage structure of the respective cache memories 50. The management information is multiplexed by the respective basic control memories 61A of the respective cluster and stored therein" as recited in claim 1, and "each of the clusters including the channel adapters, the disk adapters, and the cache memory packages recited in claim 1, as well as plural control memory packages which are used by the channel adapters and the disk adapters and have control memories storing control information. The first control information is stored in at least one of the control memories in each cluster, respectively, to be multiplexed across the clusters, and the first

control information is management information which is used for controlling an operation of the disk array device." as recited in claims 2 and 11.

A User's Guide titled "Adaptec Storage Management Software" by **Adaptec** relates to a storage management software that may coordinate with firmware to control a RAID system including a cache. A controller and I/O statistics may be monitored with software, including monitoring of cache statistics. See page 3-51, first paragraph. Likewise, device I/O statistics can be monitored according to the software. See page 3-51 to page 3-52. Firmware upgrade may be provided according to a Flash HBA option, with each component upgraded according to a separate option. See page 2-32. **Adeptec**'s cache statistical monitoring only indicates that additional cache is needed, thereby requiring introduction of additional cache and/or firmware upgrade, but not providing any cache clustering. **Adeptec** simply does not set forth a disk array device comprising plural clusters each with basic control memory packages storing control/management information of *the whole device* and expanded control memory packages storing directory information of *the respective cache.* **Adeptec** neither multiplexes management information of *the whole device* by the control/management memories. As such, **Adeptec** does not provide "each of the clusters including: channel adapters 20; disk adapters 30; cache memory packages; basic control memory packages 60A which are mounted with basic control memories 61A storing management information concerning a device configuration and a device operation of said disk array device 10; and expanded control memory packages 60B which are mounted with expanded control memories 61B storing directory information concerning a storage structure of the respective cache memories 50. The management information is multiplexed by the respective basic control memories 61A of the respective cluster and stored therein" as recited in claim 1, and "each of the clusters including the channel adapters, the disk adapters, and the cache memory packages recited in claim 1, as well as plural control memory packages which are used by the channel adapters and the disk adapters and have control memories storing control information. The first control information is stored in at least one of the control memories in each cluster, respectively, to be multiplexed across the clusters, and the first control information is management information which is used for controlling an operation of the disk array device." as recited in claims 2 and 11.

Conclusion

Based on the results of the comprehensive prior art search as discussed above, Applicants contend that the method or system as recited in independent claims 1, 2 and 11, especially the features of "each of the clusters including: channel adapters 20; disk adapters 30; cache memory packages; basic control memory packages 60A which are mounted with basic control memories 61A storing management information concerning a device configuration and a device operation of said disk array device 10; and expanded control memory packages 60B which are mounted with expanded control memories 61B storing directory information concerning a storage structure of the respective cache memories 50. The management information is multiplexed by the respective basic control memories 61A of the respective cluster and stored therein" as recited in claim 1, and "each of the clusters including the channel adapters, the disk adapters, and the cache memory packages recited in claim 1, as well as plural control memory packages which are used by the channel adapters and the disk adapters and have control memories storing control information. The first control information is stored in at least one of the control memories in each cluster, respectively, to be multiplexed across the clusters, and the first control information is management information which is used for controlling an operation of the disk array device." as recited in claims 2 and 11 are patentably distinct from the cited prior art references.

The disk array device 10 of the invention (for example, the embodiment depicted in Fig. 1) comprising plural clusters 11A, 11B, each of the clusters including: channel adapters 20 which control exchange of data with host apparatuses 1; disk adapters 30 which control exchange of data with storage devices 40; cache memory packages which are mounted with cache memories 50; basic control memory packages 60A which are mounted with basic control memories 61A storing management information concerning a device configuration and a device operation of said disk array device 10; and expanded control memory packages 60B which are mounted with expanded control memories 61B storing directory information concerning a storage structure of the respective cache memories 50 (p. 24 , 2nd paragraph). The management information is multiplexed by the respective basic control memories 61A of the respective cluster (e.g., 11A) and stored therein (p. 23, last paragraph).

The invention as recited in claim 2, is directed to a disk array device comprising plural clusters, each of the clusters including the channel adapters, the disk adapters, and the cache memory packages recited in claim 1, as well as plural control memory packages which are used by the channel adapters and the disk adapters and have control memories storing

control information. The control information includes first control information and second control information. The first control information is stored in at least one of the control memories in each cluster, respectively, to be multiplexed across the clusters (p. 24, line 19), and the first control information is management information which is used for controlling an operation of the disk array device. The second control information is stored in a separate control memory different from the said at least one of the control memories storing the first control information.

The invention as recited in claim 11, is directed to a maintenance method for the disk array device recited in claim 2, comprising: providing said disk array device; a failure detection step of detecting whether or not a failure has occurred in any one of the first control memories and the second control memories; and maintenance step of, in the case in which a failure is detected, restoring information stored in the control memory, in which the failure has occurred, using storage areas of the first control memories.

In view of all the above, clear and distinct differences as discussed exist between the present invention as now claimed and the prior art references, Applicant respectfully contends that the prior art references cannot anticipate the present invention or render the present invention obvious. Rather, the present invention as a whole is distinguishable, and thereby allowable over the prior art.

Favorable consideration of this application is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicant's undersigned representative at the address and telephone number indicated below.

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